SCIENCE

NEW YORK, JANUARY 6, 1893.

THE MICROSCOPE AND THE STUDY OF THE CRYSTALLINE SCHISTS.

BY GEORGE H. WILLIAMS, JOHNS HOPKINS UNIVERSITY, BALTIMORE, MD.

IN some preliminary pages from the Twentieth Annual Report of the Geological Survey of Minnesota, Professor N. H. Winchell has recently circulated some considerations on the structures and origin of the crystalline rocks.[1] In so far as these are the expression of a sincere desire to advance this difficult line of inquiry by summarizing results secured and by striving toward a more precise definition of terms to be employed in descriptions of crystalline terranes, they are worthy of appreciative consideration by all geologists. Certain of Professor Winchell's statements relative to the comparative value of microscopical and field evidence seem, however, liable to cause misapprehension, and it therefore appears to the writer worth while to call attention to these, at least in so far as they involve his own work on the so-called "greenstones" and "greenstone-schists" of the Lake Superior region.

No problems of geology are more intricate and at the same time more attractive than those presented by the pre-Cambrian formations. The stratigraphy, correllation, and genesis of these vast rock masses must be deciphered mostly without the aid of fossils; hence any kind of evidence, however slight, which throws real light on the questions at issue must be welcomed by the geologist and must be so thoroughly studied by him that it can be accorded its full significance.

The sub-division of the pre–Cambrian rocks into distinct formations has long been recognized as a desideratum in geology but one unattainable without minute and detailed work. General theories have proved futile for its accomplishment. Only now has the problem begun to be attacked by methods which are a stimulus for the present and a promise for the future. In Great Britain, Germany, Norway, Russia, Canada, and the United States facts are being rapidly gathered whose ultimate correlation will surely bring order out of chaos. Field study, areal mapping on a large scale, and the detailed study of stratigraphy must always be the first and most important means of deciphering a crystalline terrane. But the structure planes of the rocks are so often secondary and their original character so obscured by alteration, that stratigraphy, and indeed all field evidence, may prove inadequate to the task set for it. Then it is that help from other sources is required, and none has thus far shown itself more efficient than that furnished by the microscope.

In the history, which in the future will be written of the pre-Cambrian formations, the work already accomplished in the Lake Superior region must occupy a most honorable place. Many pioneers have there pointed out methods and secured results which the world will recognize as fundamental. There the large number of workers have stimulated discussion and has led to a constant re-examination of the same points in the light of accumulating evidence; there repeated surveys have carried on detailed mapping and the field study of stratigraphy; and there, if anywhere, the value of uniting out-of-door and laboratory methods has found demonstration.

In his present communication, Professor Winchell first summarizes the results reached by the Geological Survey of Minnesota in regard to the classification of various pre-Cambrian formations distinguishable within that State. Upon this subject the writer wishes to express no opinion. In the second section of the paper the use of terms is dealt with. A generally accepted distinction is made between constructive (metamorphic) and destructive (weathering) processes of rock alteration, and a plea is entered for some "middle ground" between the interpretations given to the various parallel structures in crystalline schists by those who hold too exclusively to either a sedimentary or a dynamic theory of their origin.

In the third division of his paper Professor Winchell discusses the comparative value of microscopic and field evidence, and it is here that the writer would take issue with his conclusions. He says: "It is in the nature of the problem involved in the study of the complicated structures and relations of some of the Archæan rocks, that the differences between the microscopic evidence and that derived from their macro-structure shall gradually fade out and that one or the other shall usurp the whole field." Later he does indeed allow that "this is not intended to shut out any individual geologist from exercising the right to employ any and all lines of research for the solution of all the problems that he has to solve," (!) but in spite of this generous permission the implication is that, after all, the ordinary mortal must be satisfied to be *either* a field, or a microscopical geologist.

Now, the writer is not aware that the most ardent advocate of the study of petrography (microscopical or otherwise) considers this branch as more than an aid to geological research. Divorced from field observation it becomes unreliable and trivial. As a supplement to field-work it is most serviceable, as the beautiful results of Iddings, Cross, Van Hise, and many others in this country (not to mention European investigators) fully show. The microscopical study of isolated hand-specimens as mere mineral aggregates once served a useful purpose, but this stage in petrography has now passed.

If, then, it be the acknowledged duty of every petrologist to be at the same time a field geologist, and to study his material in the laboratory in the light of his own observations in the field, is it at the same time too much to expect that the field geologists at work on the crystalline rocks will thoroughly inform themselves of the methods, progress, and aims of petrographical research, at least before they complain of their tendency to mislead? The microscope is now but one of the elements in modern petrographical investigation. Progress made by many workers is constantly advancing the point of view, as well as multiplying methods. Is it fair that the field geologist should remain more one-sided than the petrologist would allow himself to be? Between results obtained in the field and laboratory there is no discrepancy, except to one who incompletely comprehends one or the other method of work.

Professor Winchell says that "the sedimentary structure in a rock is one of those characters which the field geologist only can be allowed to pronounce upon with authority." If this be so, it does not follow that he who is *only* a field geologist possesses in such cases the greatest authority. If he has microscopical and other petrographical methods to aid him, it stands to reason that his opinion will be worth more. If he is certain in the field, he may, it is true, be brought to doubt by laboratory study, but this doubt is itself a gain, since there are some crystalline rocks whose origin can perhaps never be put beyond doubt.

Professor Winchell then proceeds to discuss what he calls a concrete case from the greenstones of the Lake Superior region and gives what he thinks would be the conflicting conclusions obtained by a microscopical and field study. To illustrate this case, he reproduces two figures taken from the writer's Bulletin (U. S. Geological Survey, No. 62) on the Lake Superior greenstone schists, and says: "These figures could be repeated many times in the course of a brief examination in the field. These cases present the issues fairly. It remains to be decided whether the

[1] The Crystalline Rocks, some preliminary considerations as to their structures and origin.—N. H. Winchell, Twentieth Ann. Report Geol. Survey of Minnesota, 1891.

testimony of the student who relies on his microscope and starts out with the idea of subordinating his facts to the answers it may give, or that of the field-observer, who only studies the grander structures and has a predisposition to explain such as the foregoing by referring them to sedimentation, shall here be received with the greater credence."

The Bulletin here quoted embodies the results of portions of two seasons' field-work, as well as a large amount of laboratory study of the greenstone schists. However fairly the figures may "present the issues," it is unfortunate for Professor Winchell's argument that he did not select some of the many similar examples with which his field experience has made him personally acquainted. The fact is, that the two occurrences selected by Professor Winchell from Bulletin No. 62 demonstrated in the field the dynamic origin of their structures so convincingly, that no microscopical examination was ever made of them. It would never have occurred to Professor Winchell or to any other "field geologist" to explain the particular features which, in the Bulletin, these two figures represent, by sedimentation, if they had observed the natural exposures. A single narrow shear-zone, crossing a great wall of massive diabase 60 feet in height, makes it certain, without help from the microscope, that the chlorite schist which borders the zone is the result of the fraying-out of the rock by the motion. Nor is there less certainty that the wide gaping gashes in the basic eruptives are due to some mechanical strain. There are cases without number, as every one who has worked in the crystalline schists well knows, where their is doubt as to whether a parallel structure is due to sedimentation or to dynamic metamorphism; but why Professor Winchell should select two cases as clear as these, it is difficult to understand. In the text descriptive of the original figures, it is plainly stated that the first is unsatisfactory because it represents only a *hand-specimen*, whereas the structure, to be appreciated, must be seen on the face of a high rock-wall. In regard to the second figure, it is also stated that it is only a diagramatic representation of an *area* on the rock-wall about three feet square. If there is difficulty in arriving at correct conclusions from the study of natural exposures, all the more caution is necessary in interpreting another author's figures, especially when these are distinctly described as inadequate.

In reality, what are known in the Lake Superior region as "greenstones" and "greenstone-schists" are not one thing, but a great variety of different things. Some of them are massive lavas, others accumulations of ash material stratified by gravity or water. They possess structures of diverse origin, which may to the field geologist appear very much alike. These must be studied first and foremost in the field, but to avoid confusion and misinterpretation we need all the help available, even from the microscope. Here we may see plainly that what macroscopically looks alike is in reality different. In fine, there is no discrepancy between the results of field and laboratory work, and if he who is *only* a field geologist find his conclusions at variance with those of a field geologist who is also a student of the microscope, it behooves him to revise these conclusions before he casts asice the results of modern petrographic research.

WORCESTER SCHOOL CHILDREN. — THE GROWTH OF THE BODY, HEAD, AND FACE.

BY GERALD M. WEST, CAMBRIDGE, MASS.

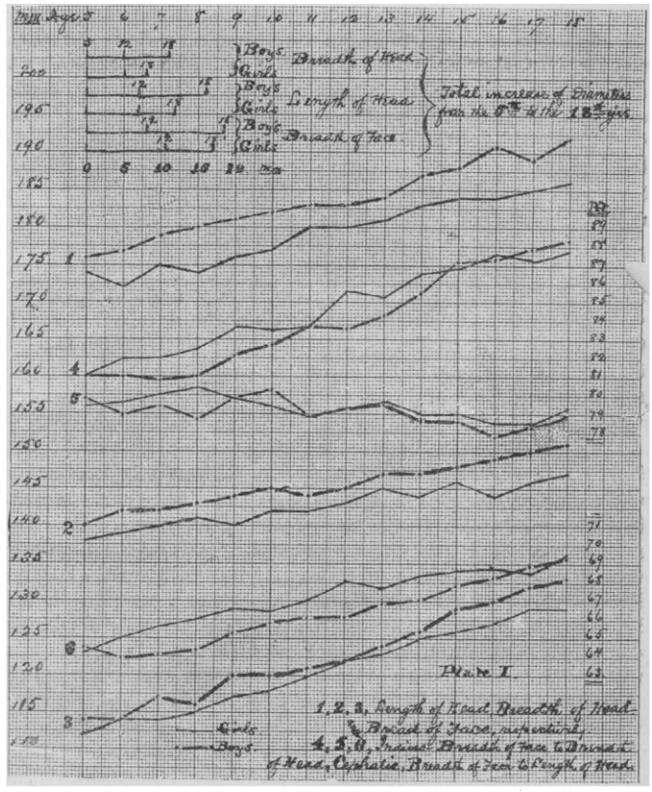
AN investigation into the laws governing the growth of various parts of the body was instituted in the Worcester schools in the spring of 1891, and a short notice of the growth in width of the faces of girls was published in *Science* (July 3, 1891). I now propose to give a summary of some of the other results obtained.

The observations were made in the primary, high and normal schools, and in two of the private schools in the city of Worcester. The number of individuals examined was 3,250, the ages ranging from 5 to 21 years. The nationalities were numerous, but about 66 per cent were of American parentage, 20 per cent of Irish, 7 per cent of English and Scotch, and 6 per cent scattering.

Plate I. contains the curves of growth of the diameters of head and face, with their indices.

Absolute measurements.	1. The maximum length measured from the glabella.	Head.
	2. The maximum breadth.	
	3. The " " of the face.	
Indices.	4. The proportion of the breadth of the face to the breadth of the head.	
	5. The proportion of the breadth of the head to the length of the head.	
	6. The proportion of the breadth of the face to the length of the head.	

Length of Head (1). — In absolute length we see that the girls' length of head is less than that of the boys throughout its whole period of growth, and consequently throughout life. We find, however, that this difference in length does not remain the same year by year, but varies considerably, being, for example, 3 millimeters at the ages of 11, 12, and 13, and rising as high as 6 millimeters before, and 7 millimeters after, that age. We find also



that the annual increment is very irregular in both sexes. We have periods of growth alternating with a cessation of growth.

In girls the greatest length of head is reached at about the beginning of the eighteenth year. In boys the head continues to grow until at least the age of twenty-one. The period of greatest irregularity in the annual increment seems in the case of girls to be before, in the case of boys after, the eleventh and twelfth years.

Breadth of Head (2). — The breadth of head presents phenomena very similar to those of the length of head, i.e., periods of alternate growth and cessation of growth. The girls' width of head is less than that of the boys, but the difference diminishes markedly about the eleventh year, from this age until the fourteenth year the curves are parallel, then this again becomes more widely separated. The age of maximum width in girls is about seventeen, in boys the maximum is not yet reached at the age of twenty-one.

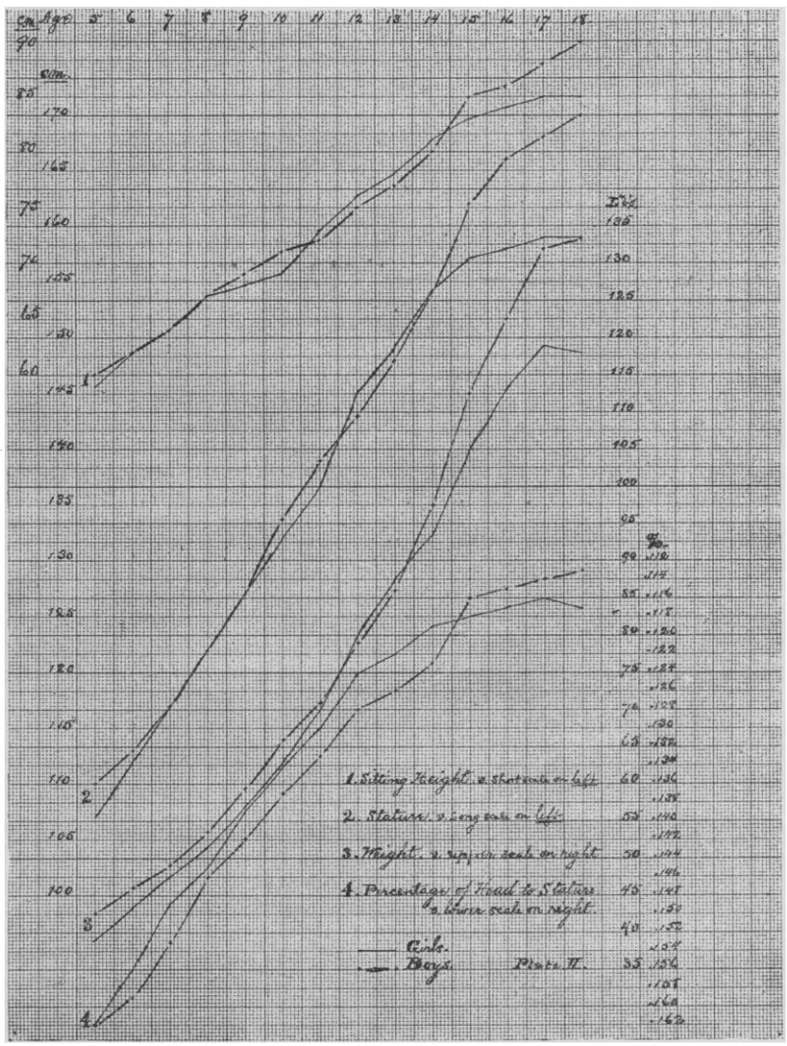
Breadth of Face (3). — Here again we meet with similar phenomena; the breadth of face of the girls increasing rapidly with irregular annual increments until the seventeenth year, when the maximum growth is reached. The faces of the boys continue to grow until the eighteenth year and probably beyond.

As in the case of the two preceding diameters, the breadth of face of the boys exceeds that of the girls. But there is this slight difference here; the diameters of the girls' heads approached more nearly those of the boys' heads during a certain period, approximately, from the eleventh to the thirteenth years; but in the diameter of the face the girls not only approach, but at the twelfth year seem quite to reach that of the boys.

These three curves evidence four things: first, that the time of growth in the diameters of the heads and faces of girls is shorter than in the case of boys; second, that up to about the twelfth year these diameters grow more rapidly in girls than in boys, while after that age the contrary is the case; third, that by an apparently sudden rise in the annual rate of growth in the girls their diameters approach much more nearly that of the boys during the period of the eleventh, twelfth, and thirteenth years. Finally, the average annual rate of growth in the diameters of the girls heads and faces is nearly uniform during the two periods before and after the eleventh-thirteenth years. While in the case of boys it is considerably greater, actually and relatively, after than before. Between the fifth and the eighteenth years the length of head of boys increases 16 millimeters, in the same period the breadth of head increases 11 millimeters, and the width of face 18.5 millimeters. The corresponding measurements in the case of girls increase 12 millimeters, 8 millimeters, and 17 millimeters, respectively, for the same period of time. The horizontal lines on the upper left hand of the diagram indicate the entire altitude of the curves, the cross-bar indicating the altitude at twelve years. A comparison of the annual increments of the length of head and of the breadth of head seem almost to suggest an alternation in growth between the two diameters, as we shall see, the alternate rising and falling of the curves of the cephalic index would seem to strengthen this suggestion.

Let us now turn to the three indices, numbered on the plate 4, 5, and 6 and taking up as first in order the cephalic index.

The Cephalic Index (5). — The curve of the cephalic index shows, as would be expected from an examination of the component curves of length of head (1) and breadth of head (2), a considerable degree of irregularity in its annual stages. There is, nevertheless, a certain general regularity displayed, taking the curves as a whole; both displaying three periods, composed each of a decided maximum and minimum. These periods are from about the fifth to the eleventh, the eleventh to the sixteenth, and the sixteenth on in girls; from the fifth to the tenth, from the tenth to the thirteenth, and from the thirteenth to the eighteenth in boys. The whole range of the two curves is very small, scarcely two and a half per cent; the final index being, for boys, about one and one-half per cent below that of the index at five years of age; the final index of the girls being very nearly the same as at five years of age. The greatest altitude of the curve is, for boys, at ten years, and for girls at eight years. The greatest depression is at about sixteen years of age for both sexes. The cephalic index of girls is for the period of growth higher than that of boys, except at about the ages of nine and ten.



Breadth of Face to Breadth of Head (4).— In comparing the growth of the breadth of the face to the breadth of the head, we find that the breadth of face grows much more rapidly propor-

tionately than the breadth of head. This is shown by the rapid rise of the curve of the index. That the increase is actually greater than the width of face we have already seen. The breadth of face as compared with the breadth of head is greater in the case of girls than in the case of boys until the fifteenth year, at which time the boys' curve becomes the higher, falling again the next year, and rising finally in the seventeenth year.

Breadth of Face to Length of Head (6).— As in the index just discussed, the breadth of face increases more rapidly proportionately than does the length of head. We have the index of the girls higher than that of the boys until about the sixteenth year, when the two curves intersect, that of the boys becoming the higher for one year, and again falling below in the eighteenth year.

We see, therefore, that in proportion to the length of head, the width of head and the width of face of girls are generally greater than those of boys, and that in proportion to the width of head the width of face also is greater in girls than in boys.

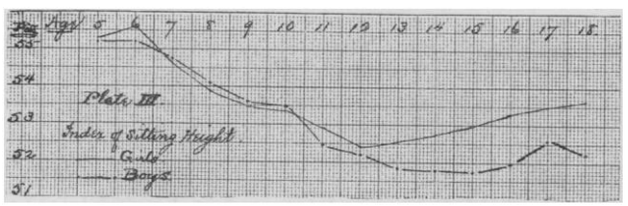
Body measurements (Plate II.):—

1. Sitting height.— Vertex to oleacronon, approximately.
2. Stature.— Standing erect without shoes.
3. Weight.—In in-door clothing.
4. Comparison of length of head to stature, expressed in per cents of stature.

Plate III.:—

Index of sitting height.— Comparison of sitting height to stature, expressed in per cents of stature.

The Stature (2).— Taking the stature as properly first in order, we find the boys starting out at five years of age apparently taller than the girls, but the girls appear to catch them in the seventh year and continue at an equal stature up to and including the



ninth year, after which the boys again rise above the girls for two years. At about the twelfth year the girls suddenly become taller than the boys, continuing taller until the fifteenth year, when the boys again and finally regain their superiority in stature. After the age of seventeen, there seems to be very little if any increase in the stature of girls while the boys are still growing vigorously at eighteen, and probably continue to grow for several years after that age.

The intersection of the two curves at the ages of twelve and fourteen is a more accentuated instance of the phenomenon which we have already met with in the curves of the diameters of the head and face. We shall see it again in the curves of sitting height and of weight.

The Sitting Height (1).—The curves of the sitting height present the same characteristics, somewhat more accentuated, as the curves of stature. The boys start out at five the taller, but by the next year the girls are of equal stature and continue equal until and including eight years of age. From eight until eleven the boys are again the taller. In the eleventh year, nearly a year earlier than in the case of stature, the girls shoot ahead of the boys, the latter not regaining their superiority until the fifteenth year, about half a year later than in the case of stature. Again, we find the girls' curve stopping abruptly at seventeen, while the boys continue to grow for some years longer.

The Weight (3).— The curves of weight, while preserving the general characteristics of the curves of stature and sitting height, show minor differences. The boys are in all years from five to eleven inclusive heavier than the girls. From the twelfth to the fourteenth year the girls are the heavier. From fourteen on the boys are again superior in weight. The superiority of the girls in respect to weight is for a much shorter period than in respect to total height or sitting height.

In weight, also, the girls seem to reach their maximum average at seventeen, the boys continuing to increase in average weight until a much later period in life.

Comparison of Length of Head to Stature (4).— The curves of this index bear a strong resemblance to those of stature. From this comparison it seems that until the fifteenth year the length of head of girls is less in proportion to their stature than is that of boys to their stature. At fifteen the ratio of the boy's length of head to their stature suddenly drops, while that of the girls gradually rises, indicating that in the adult the heads of women are proportionately longer than those of men. This is also true of the width of head and the width of face.

The Index of Sitting Height (Plates III.).— These curves, starting at a high per cent at five years of age, drop rapidly until the twelfth year in the case of girls and the fifteenth in the case of boys. From the twelfth year on the girls' curve rises; from the fifteenth to the seventeenth years, inclusive, the boys' curve also rises, but drops again during the next year. These movements of the curves seem to indicate that the greater part of the growth in stature, up to the twelfth year in the case of girls and until the fifteenth year in case of boys, is made in the lower limbs, while after these respective ages it is made in the trunk. Except for about two years, throughout the period from five to eighteen, the limbs grow more rapidly than the trunk in boys, while in the case of the girls the period of greater comparative growth is divided nearly equally between the extremities and the trunk. Except from about the seventh to the tenth year, the trunk is proportionately longer in girls than in boys, after the thirteenth year the difference is much more marked.

As we found in the case of the diameters of the head and face, girls grow more rapidly than boys up to twelve years of age, less rapidly after that age. Comparing the two periods, we find that in the case of stature and sitting height the annual rate of increase for girls is considerably less after twelve than it was before it. The boys maintain the same rate throughout. Although both sexes make greater annual rates after than before twelve, yet the girls make their greatest absolute increase before, the boys theirs after, that period.

These results seem conclusive evidence that women reach maturity several years before men. There seems little doubt that for all the measurements of the body, except the weight, girls have completed their growth by the eighteenth year.

BIRD-MUSIC IN AUGUST.

BY MARY HYATT, STANFORDVILLE, N.Y.

Much has been written about the songsters of spring and early summer, but there is something of a lack of information concerning the birds that sing in August. It would be interesting to compare notes from different localities on this subject.

Bird-music in this month of oppressive heat is doubly welcome, and the few singers that help to enliven the sultry days should receive their share of attention and praise.

Burroughs says that there are but four songsters that he hears "with any regularity after the meridian of summer is past, namely, the indigo bird, the wood or bush sparrow, the scarlet tanager, and the red-eyed vireo." He further observes that "birds sing as long as nidification goes on. . . . Hence our wood-thrush will continue in song into August if, as frequently happens, its June nest has been broken up by the crows or squirrels." The wood or bush sparrow mentioned is, we think, Spizella pusilla, a faithful little minstrel of morn and eve all through the heated term. The goldfinch, whose lively notes as he dips and rises through the air are so prominent in mid-summer, and whose canary-like song is occasionally heard, should certainly be included among August songsters. With us the yellow throated vireo is as regularly tuneful in August as the red-eyed, while the white-eyed vireo is heard now and then.

In a note-book kept through August of 1889, we have an account of such birds as were in song for many days during the month in our vicinity. Beginning Aug. 3, we have on record: Indigo bird, chewink, Baltimore oriole, wood pewee, red-eyed

vireo, phebe bird, song, field, and chipping sparrows. When out riding on Aug. 4 we heard the strain of a meadow lark, and on the 6th the noisy tirade of a white-eyed vireo.

On Aug 8 the note-book tells of a fine concert, when a goldfinch, an indigo bird, field, song, and chipping sparrow sang, an oriole whistled a few times, and a yellow-throated vireo was tuneful by spells for a long while.

Aug. 15. Red-eyed vireo, chewink, and field sparrow; 16th, yellow throated vireo, phebe, goldfinch; 17th, oriole, chewink; 18th, red-eyed vireo; 19th, yellow-throated vireo, and "orioles make themselves heard nearly every morning now." Aug. 21, field sparrow, wood pewee, and black and white warbler.

Aug 29. "The yellow-throated vireo sings nearly every day — almost the only bird we hear nowadays. Yesterday we noticed the songs of a goldfinch and a song-sparrow; chickadees also were musical." This closes the month's record, but it is noted down as something unusual, that the yellow-throated vireo continued to sing during every forenoon for the first six days of September.

There are usually a few fiery days in mid-summer when nearly every bird is silenced, but rarely an August morning passes without a salute to the dawn from sparrow or goldfinch.

A RARE FORM OF POLISHED STONE IMPLEMENTS AND THEIR PROBABLE USE.

BY WALTER HOUGH, WASHINGTON, D.C.

AMONG the collections from Mexico, Central and South America, exhibited in the Columbian Historical exposition at Madrid, the writer noticed a number of oblong polished blocks of hard stone of unknown use, averaging 3¼ inches in length, 2⅜ inches in width, and 1½ inches in thickness. The broad surfaces of these stones are plane, bearing a number of grooves parallel to the length, froming ridges like those seen on Polynesian tapa mallets.

The edges, as a rule, are hollowed out by pecking, seemingly for convenience in grasping the block, so that the section is that of the modern eraser for the blackboard. Often these blocks are only nicked at the corners, and usually two sides and one end only are hollowed out, which seems to indicate that they were mounted in a handle, perhaps by means of a wythe going around the hollowed edge.

In most cases both sides are ridged, one side coarse and the other much finer; a peculiarity noticed in the Polynesian mallet of square section, which often bears four grades of ridges, which are used successively in reducing the bark to thinner texture.

Only one of the blocks seen is round in outline; a few others have rounded corners; the ridges are parallel and the ridged surfaces perfectly flat. An aberrant block of this type, which is probably a stamp, has a convex surface, with sawed diagonal grooves crossing (hatchwork) at either end bounding a band of horizontal lines enclosing shallow bored pits and a central series of shallow bored circles with cores.

The material is usually hard basalt or porphyritic rock, and the channels bounding the ridges are fine examples of sawed work.

The resemblance of these objects to those used by so many different peoples, in beating out fibrous bark for clothing, paper, etc., is very striking. May it not be said that this is a pre-historic implement for the same purpose, and that they give an insight into the manufacture of the paper upon which the Mexican codices are painted? In Costa Rica, Nicaragua, and certain countries of South America, the present aborigines use ridged wooden mallets resembling the Polynesian for making bark clothing.

It may also be affirmed that there is no other form of implement than the one having the combination of ridges and grooves, that is useful in expanding and separating the fibres of bark evenly without rupture, which is evident from the effect produced by the blow.

The distribution of the 31 bark-beaters measured and described by the writer is as follows: Mexico, 25; divided among the Nahuas, (12); Totonacs, (1); Tarascos, (6); and the Miztecs-Zapotics, (6). One of these in the Mexican collection has been channeled, probably by the Tarahumares, and adapted for one side of an arrow-smoother, the other side is a smaller block of freestone of reddish color. This was taken from a cave anciently inhabited by the Cromachi. Two bark-beaters are from Nicaragua; one in the collection of Dr. Carlos Bovallins of Upsala, Sweden, and the other from the exhibit of the government of Nicaragua. One specimen is from Columbia in the collection of the Archæological Museum of Madrid and three from the exhibit of Costa Rica.

After examining the paper upon which the Mexican codices are written, the opinion is expressed that it is not made from the magney, but is from a tree furnishing bark available for paper, probably of the family to which the mulberry belongs.

ETHNOGRAPHICAL SURVEY OF THE UNITED KINGDOM.

BY E. W. BRABROOK.

IN the early part of 1892, on the suggestion of Professor Haddon of Dublin, the Society of Antiquaries of London, the Anthropological Institute, and the Folk-Lore Society appointed delegates to discuss the means of combined action for obtaining simultaneous observations on the monuments of antiquity, the physical characters of the people, and their customs, traditions, and beliefs in various parts of the United Kingdom. They agreed to seek the co-operation of the British Association, which has local corresponding societies in connection with it, and received authority to act as a committee of that association, with the additions of a delegate from the Dialect Society, and of others specially representing Wales, Scotland, and Ireland. It was generally admitted that the success of the work depended upon its being taken in hand at once, since the forces impelling country folk towards the great towns, and the rapid means of transit from place to place now available to the very poorest, are fast effacing all special local peculiarities, and mixing up inextricably the races of which the population is composed.

The first step of the committee has been to issue a circular to persons known to be well acquainted with the rural districts, requesting them to indicate such villages and places as appear especially to deserve ethnographic study, so that a list might be formed, out of which a selection might afterwards be made for the survey. The villages or districts suitable for entry on the list are defined to be such as contain in general not less than a hundred adults, the large majority of whose forefathers have lived there so far back as can be traced, and of whom the desired physical measurements, with photographs, might be obtained. For such typical villages and the neighboring districts the committee propose to record (1) physical types of the inhabitants, (2) current traditions and beliefs, (3) peculiarities of dialect, (4) monuments and other remains of ancient culture, and (5) historical evidence as to continuity of race. In each such place they will endeavor to obtain the assistance of observers resident in the locality.

The response which the committee have obtained to this preliminary inquiry has been more general and encouraging than they had expected. In some places they have been met with the lament, — this ought to have been done fifty years ago, and it is now too late; but from numerous others, in all quarters of the three kingdoms, they have received information of places where the people are still primitive in their ideas and customs, unaffected by intercourse with strangers, and bear a marked strain of one or other of the races by which this country has been peopled. For the use of these informants, a brief code of directions is being prepared.

This endeavor to record the natural history of the elements which go to make up the population, so far as they can be traced in the localities where its race-elements have remained undisturbed, will, I have do doubt, interest many of those whose ancestors have carried to the United States some recollection of the peculiarities and customs of the people of that part of the United Kingdom from which they sprung.

The Journal of Hygiene will be the name of the *Herald of Health* on the 1st of January, 1893. The *Herald of Health* is now in its 43d year and has been edited since 1866 by Dr. M. L. Holbrook. The journal is published in New York, at $1 a year.

SCIENCE:

PUBLISHED BY N. D. C. HODGES, 874 BROADWAY, NEW YORK.

SUBSCRIPTIONS.—United States and Canada ....$3.50 a year.
Great Britain and Europe..... 4.50 a year.

To any contributor, on request in advance, one hundred copies of the issue containing his article will be sent without charge. More copies will be supplied at about cost, also if ordered in advance. Reprints are not supplied, as for obvious reasons we desire to circulate as many copies of *Science* as possible. Authors are, however, at perfect liberty to have their articles reprinted elsewhere. For illustrations, drawings in black and white suitable for photo-engraving should be supplied by the contributor. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

Attention is called to the "Wants" column. It is invaluable to those who use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

HOW MANY ARCHÆAN ROCK-GROUPS HAVE WE IN GREAT BRITAIN?

BY CH. CALLAWAY, D.SC , M A., F.G.S., WELLINGTON, SHROPSHIRE, ENGLAND.

RECENT geological research amongst the pre-Cambrian rocks of North America, while it has settled some points, has unsettled others. A generation ago the terms "Laurentian" and "Huronian" were thought to have a clear and definite application. At that time, we in Great Britain knew of only one Archæan group, called Hebridean or Lewisian, and supposed to be the equivalent in time of the Laurentian. Later on, British geologists discovered a second pre-Cambrian formation, the "Pebidian" of Dr. Hicks, or "Uriconian" of the writer. This great volcanic system bore many resemblances to the published descriptions of the Huronian, and it was referred with more or less hesitation to that group. Meanwhile, Dr. Sterry Hunt was creating more systems in America. We heard of his "Norian," "Moutalbian," "Taconian," and "Keweenian," and every year we looked for new worlds from his prolific brain. Unfortunately, subsequent research in the United States and Canada has but very partially confirmed Dr. Hunt's results, and even our faith in "Laurentian" and "Huronian" has been somewhat confused. "Huronian" appears to be several things, and "Laurentian" in some localities is said to be an intrusive granite. Nevertheless, it appears to be generally admitted that in North America there are gneisses and granites which are older than any other rock-masses, and that in the same region there are volcanic formations which are younger than these crystallines, and more ancient than the Cambrian; so that the old notions on "Laurentian" and "Huronian" remain true in a general way. It would also seem that North America contains sedimentary rocks which are newer than the Huronian, and are yet pre-Cambrian. Thus it would hardly be rash to conclude that, on the western side of the Atlantic, there exist at least three Archæan roch-groups, a gneissic, a volcanic, and a sedimentary, and that they succeed each other in the order here given. Now it is interesting to remark that this description agrees with the latest results of research in Great Britain. We have first of all the gneisses and schists, which in Scotland are called "Hebridean," and "Malvernian" in England. We cannot say that these formations are the exact equivalents of each other, and it would certainly be rash to assert that they. or either of them, can be correlated with any rock-masses the other side of the Atlantic. Nevertheless, they are admitted to be the oldest rocks in Britain, and, in the opinion of the writer, they are separated by a considerable interval from the formation which comes next. This great volcanic system holds the place originally assigned to it in the Archæan series by Dr. Hicks and the writer. Its pre-Cambrian age has been admitted by Sir A. Geikie, director-general of the Geological Survey of Great Britain and Ireland, so far as the Uriconian rocks of Shropshire are concerned; but he assigns the Pebidian of St. Davids to the base of the Cambrian. In the opinion of the writer, the volcanic rocks of St. David's are truly pre-Cambrian; so that the name "Pebidian," originally given to them by Dr. Hicks, has priority over the more modern term "Uriconian." These rocks are of wide distribution, being found in North and South Wales, at Charnwood, near Leicester, in many parts of Shropshire, in the Malvern Hills, and probably at Howth, near Dublin. Evidence has recently been collected of a third pre-Cambrian system. Near Church Stretton, in Shropshire, is a chain of hills, forming Longmynd, built up of conglomerates, sandstones, and slates. Murchison called these sediments "Bottom Rocks," and he referred them to the Lower Cambrian. This view has been adopted by the English Geological Survey, and generally accepted. Recently, however, evidence has been collected which makes it almost certain that this formation is of pre-Cambrian age, and the present writer has given it the name "Longmyndian." The true basal Cambrian, a band of quartzite, occurs in close proximity to the Longmynd rocks, though not in absolute contact; and it is incredible that the Longmyndian, which is some miles in vertical thickness, should be a mere subdivision of the Cambrian, which is found in three of its four members within a few miles to the east. It would seem, then, that on both sides of the Atlantic, the Archæan (or pre-Cambrian) series consists of (at least) three members, gneissic, volcanic, and sedimentary, which follow each other in the same order, suggesting a similarity of conditions in both areas in the successive epochs of Archæan time.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Is the Maya Hieroglyphic Writing Phonetic?

In No. 505 of the *Science*, Professor Cyrus Thomas devotes a few more pages to the problem of the Maya hieroglyphic writing. "These," he says, "may perhaps be profitable to the subject, if confined to an earnest endeavor to arrive at the truth." The "additional evidence," introduced in this manner by Professor Cyrus Thomas, he has seen fit to precede by some remarks intended to invalidate the criticism I offered in this paper some months ago (*Science*, Aug. 26). My answer to these remarks is presented in the following lines, which, I trust, will also be profitable to the subject, although I do not claim to be the only scientific man that "earnestly endeavors to arrive at the truth."

Professor Thomas is correct in stating that "a dot and two crosses with a month-symbol form a date in the bottom line of Plate 49, Dresden Codex." Nevertheless, I firmly believe I can maintain that "there does not exist a numeral designation with crosses *between* the dots." I have never seen it in the Codices. On the other hand, I found, for instance, on the sides of the Stela J of Copan (Maadsley, "Biologia Centrali Americani," Pl. 69–70) that the *one* dot of the numerals 1, 6, 11, and 16 always is framed by two ornamental signs, but there is never an ornamental sign between the *two* dots of the numbers 2, 7, and 12. Compare the Figs. 1–16 of the adjoined table. Moreover, I think, the analogy between the two hieroglyphs, Figs 29 and 30 (of my former paper), is obvious. Since in the one case the two dots and the cross are a part of the hieroglyph and not a numeral, I hope, it will not be a fault of veracity to believe the same in the other.

Professor Thomas says I am not correct in stating that Fig. 30 (of my former paper) is the glyph he interpreted "moisture." "True, the parts are similar," he says, "but the details and surroundings are different." In the adjoined table I reproduce the Fig. 30 of my former paper by Fig. 17, and Professor Thomas's moisture symbol by the Fig. 18. Certainly, the surroundings are different. In Fig. 17 the hieroglyph is placed on a dish, in Fig. 18 on the hand. And there are wanting in Fig. 18 the two dots and the cross that are seen in Fig. 17. But the parts are not


1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.
13.
14.
15.
16.
17.
18.
19.
20.
21.
22.
23.
24.
25.
26.
27.
28.
29.
30.
31.
32.
33.
34.
35.
36.
37.
35a
35b

"similar,' but essentially the same. And that the whole hieroglyph is really the same, is proved by comparing Figs. 19 and 20 of the adjoined table, taken from the Dresden Codex, 18^a and 19^c. In Fig. 20 the hieroglyph of Fig. 17 is the first hieroglyph of the text. Its representative is shown in the hieroglyph carried on the back of the woman figured below. This representative of the text-hieroglyph exhibits the same elements in the same order as Professor Thomas's moisture-symbol held on the hand of Fig. 18.

Professor Thomas asserts that my statement that the first glyph shown in his Fig. 2, p. 46 (*Science*, July 22), is the same as that in certain groups mentioned by me, and Figs. 31–33 (of my former paper) are incorrect, as I had failed to include the prefix. The character of my first figure, he says, is the same, but the characters of my two other figures are different and give a different word. The first character Professor Thomas had interpreted *u-zabal*, "set the snare." Respecting the latter, he says, it is possible that the signification is suggested by *haɔab*, "a sword, weapon to wound with, a whip." This agrees, Professor Thomas asserts, "very well with what we see in the hands of the figures below, and also with the general tenor of the series." True, instead of naming one character and one series, I ought to have spoken of two allied characters and two allied series. But my objections to Professor Thomas's interpretation were chiefly based on the fact that each one of the two hieroglyphs is the leading character in a *series* of representations, embracing different actions, and not only the "setting of the snare." The first character is the leading hieroglyph in the series Figs. 26–31 of the adjoined table; the second one in the series Figs 32–35. It is obvious that — although there are represented different persons and animals — the general tenor of the two series is essentially the same. Both, undoubtedly, refer to capturing animals, showing the deity armed for hunting and different captured animals. Now, it can be proved that the leading character of the hieroglyphic groups of a series suggests the action in which the persons figured below are represented (compare, for instance, Codex Dresden 4^c and 7^c and the two leading hieroglyphs in Codex Dresden 12^c, Codex Troano 19^c, etc.). As, in our case, the general tenor of the two series is the same, the first of our characters (Figs. 26–31) will be intended to indicate the same action as the second one (Figs. 32–35). We must conclude, therefore, that the second part, which is common to the two hieroglyphs, is the essential one; and that the other, the so-called "prefix," is subordinate, referring to circumstances of minor importance, perhaps interchangeable. This conclusion will be proved once more by the fact that the second part occurs alone, and apparently with the same general signification (see Fig. 35^a, taken from Dresden Codex 60^a).

As to Professor Thomas's interpretation, the name *haɔab* he gives does not agree with his own alphabet. For the element in question, the knot or loop, seen on the top of the second part of the hieroglyph, according to Professor Thomas's alphabet, does not express the sound of the "letra herida" ɔ, that is to say, *ts'*, but that of *z*, or *s*. The word itself is not *ha-ɔab*, as Professor Thomas reads, but *haɔ-ab*, an instrumental noun derived from the verb *haɔ*, "to whip, to wound." Finally, it is obvious that the rendering, "sword, a weapon to wound with, a whip," does not more agree "with what we see in the hands of the figures below, and also with the general tenor" of the second series (Figs. 32–35), as it would agree with that of the first one (Figs. 26–31). I may safely abandon to the reader's judgment to decide whose interpretation in this case is the more based on "mere assumptions," Professor Thomas's or mine, and who has more earnestly endeavored to arrive at the truth.

Professor Thomas acknowledges the correctness of my statement that the sign of aspiration found in Brasseur's "Landa" is not in the original text. "Nevertheless," he says "we have to thank the Abbé for a happy suggestion. . . . I may add that Dr. Seler has gone farther than Brasseur, as he has given us in his 17^a a character which appears to be new, — at any rate, I have been unable by a careful search to find it in any of the codices." I refer Professor Thomas to the Figs. 23–25 of the adjoined table. These, and some other variants, act as leading hieroglyphs in a series of twenty-nine hieroglyphic groups, accompanying as many figures of the rain-god. My Fig. 23 contains the element in question, with exactly the same characters as I rendered them in Fig. 17^a of my former paper. This Fig. 23 occurs three times in the series, in Dresden Codex 30^c, 31^c, and 39^c. Professor Thomas, therefore, has not carefully searched. To call a notorious falsification "a happy suggestion," and to stigmatize a correct statement as a conscious falsification (I say it with due regard to courtesy), we are not wont to consider as an earnest attempt to arrive at the truth.

Professor Thomas argues that I had criticised his article without having thoroughly read it, because, in the fourth character of his Fig. 4, I overlooked, he says, the little item on the front of the face. Had I but looked to his Fig. 3, I would not have fallen into the error of considering the two as the same. I regret to say that the writer of the Dresden Codex has fallen into the same error, since he mentions the deity, seen in the Figs. 21, 22, of the adjoined table, in Dresden Codex 5^a by the first hieroglyph, Fig. 21, in Dresden Codex 13^b by the first hieroglyph, Fig. 22, both differing from another in "the little item on the front of the face," nearly in the same way as the characters of Professor Thomas's Figs. 3 and 4 (*Science*, p. 45) differ from another.

Professor Thomas himself, in most cases, has overlooked the notorious existence of variants of writing and the replacement of one element by another. He says, "To assume that the Fig. 29 (of my former paper) is a variant of Fig. 30, is certainly straining a point to the utmost tension." I could show to my opponent more curious variants. As to the mutual replacement of the element *Kin* and Professor Thomas's "letter-glyph" *b* — that, in my view, renders the sound *Kan* "yellow" — I refer him to Figs. 36, 37, of the adjoined table, the first showing the leading hieroglyphs of Cort. 21, Tro. 35^d, the latter those of Codex Tro. 24* 23^{*a}.

Professor Thomas concludes his objections against my criticism with the following phrase: "I must confess that his (Dr. Seler's) eyes are sharper than mine, if he can find any figures in either of the Codices representing a god or any one else beating a drum. This, like other of his assertions in regard to the significance of other figures, appears to be 'merely hypothetical.'" My reply to this apostrophe is the Fig. 40, taken from Dresden Codex 34^a, which, for the benefit of the reader, I have contrasted with two Mexican paintings, Figs. 38 and 39, taken from Codex Borgia 55, and Codex Land. 39. In the two Mexican paintings, a goddess is seen and a god, the latter beating a drum, in Fig. 39, curiously held between the legs. No scholar versed in Mexican prolographic style, will deny that the instrument seen in those paintings is really the drum, the *tlalpan-neuetl*, made of wood and covered with a tiger-skin. Compare Fig. 42^a, the well-known musician of the Mendoza Codex. Now the god of Fig. 39 has his exact counterpart in one of the persons of Fig 40. Here, in the very middle of the scenery, we have the head of the sacrificed (or the dead deity) exposed on the top of the altar-pyramid. On the left side a fire is burning, and below it an offering of maize is placed on a dish. To the right hand other offerings are seen, consisting of a meal of maize and turkey, and of a meal of maize and certain other game. Four persons sit around, playing different instruments. On the upper part of the left side, a black-colored person holds the *chicauaztli*, the well-known rattling staff of the Mexican paintings (see "Compte Rende, VII. Sess. Congr. International Américanistes," Berlin, 1888, p. 661–664, and "Veröffentlichungen aus dem Königlichen Museum für Völkerkunde," I., p. 147, 152). Below him a woman beats a drum of curious form. The music is seen rising from the end of the instrument. To the right hand of the altar, in the lower part, a man is playing a flute. Here, also, the music is seen rising from the lower end of the flute. The upper figure, on the right side, with one hand shakes the rattle and with the other beats the drum, held between the legs exactly in the same manner as with the god of the Codex Land. (Fig. 39). Another series of musicians occurs in Codex Tro. 24* 23^{*d}. Here a person, exhibiting a black-colored skin, like that of Fig. 40, is seen with the *Chicauaztli* in the one hand, and a rattling-ring (?) in the other (Fig. 41), while another deity (Fig. 42) is beating a drum. On

the top of the figures I reproduce the leading hieroglyphic that accompanies the figures and undoubtedly refers to the general tenor of the series. The curious form of the instrument of Dresden Codex (Fig. 40) occurs also on Plate 24 of the Codex Tro., together with another more regular form (see Figs. 43 and 44 of the adjoined table). And considering the former (Fig. 43) and the other figures of the instrument represented above, I think, nobody will doubt that also in the figures of Codex Cortes 21a and Codex Tro. 35b (Fig. 46 of the adjoined table) the writer intended to represent a drum. We shall the less doubt of it, as this action here is accompanied by hieroglyphs (Fig. 45), the one of them exhibiting the same characteristics as those accompanying the musicians in Figs. 41 and 42. We have, thus, in the known Maya Codices at least five well characterized representations of persons or gods beating a drum. My mentioning, therefore, of a god beating a drum was not "merely hypothetical," not a "mere assumption," but based wholly on proofs.

I shall not go into further details; nor shall I attempt to criticise the "additional evidence" brought forward by Professor Thomas in his last article, or to discuss the probability of that

curious enumeration of historical facts occurring every 177 days, for the space is limited. Only, by the way, I note that Professor Thomas interprets phonetically *Xaman* as "north," the character that, in reality, designates *nohol* "south" (see the evidence adduced by me in "Zeitschrift für Ethnologie," XXIII., p. 104). His third sample of the use of his "letterglyph" *b* is one of those interesting hieroglyphs that change the so-called "prefix" according to the four cardinal points. Compare Figs. 47, 48 of the adjoined table, the former taken from Codex Dresden 29, 30c, the latter from Codex Tro. 31, 30d. These varying elements undoubtedly are indicating the names of colors, as each of the four cardinal points was distinguished by a special color. And the so-called letterglyph *b*, with all probability, has to be considered as expressing the element *Kan* "yellow" (see "Zeitscrift für Ethnologie," XXIII., p. 108, 109). The explanation Professor Thomas gives of the five dots, seen under certain hieroglyphs, as rendering the sound *ho* "five," will receive a curious illustration by the varied form these dots exhibit, for instance, in the Fig. 35b, taken from the Dresden Codex. It does not appear, with all, that the samples of interpretation presented by Professor Thomas in his last paper are more satisfactory than those of his former one. It will be seen, indeed, that there is no reliance in the simple fact that, applying a certain key, the parts give apparently appropriate results. In a similar way there could be proved and has been proved that the Mexican and Peruvian languages are derived from Sanscrit, and that the descendants of the lost tribes of Israel survive in the Southern Sea. The right, Professor Thomas claims, to apply such a key has to be proved in the first place. I am awaiting if, in the paper he is preparing for publication by the Bureau of Ethnology, he will be able to do so.

DR. SELER.

Steglitz, Germany, Dec 18.

Irrigation Surveys.

I HAVE just had the pleasure of perusing your issue of the 16th, with its review of Irrigation Work by the General Government. Allow me, in returning my thanks for the comprehensive references made, to make some brief corrections:—

In the first place, then, the expenditures of the Geological Survey as to "irrigation" work, have been that of two appropriations — in all $350,000. This is wholly outside of printing, which is paid for under other appropriations. The cost thereof will not be less than $15,000. Besides these two direct sums of $100,000 and $250,000, with the printing of Part II. in Annual Reports 10 and 11, the Survey for work in the Arid Region, topographic and hydrographic, has had two more annual appropriations of not less than $100,000 in all. The terms of the appropriations were designed unquestionably to continue indirectly irrigation work which Congress had declared should not be continued by the Geological Survey. Its irrigation work, then, has cost much nearer $500,000 than it has $235,000. Its results are two finely printed volumes — one of 123 pages and the other of 395. In the latter are 80 or 90 pages of matter previously printed — the larger part of it, indeed, having been twice printed by committees of the Senate and House. The reprint in Report Eleven is of Major Powell's testimony and argument before the House Select Committee on Irrigation, 51st Congress, which in substance and effect is the same that Director Powell made to the Senate Committee at the same session. So, in effect, it has cost nearly half a million dollars to publish 419 pages of "original" reports. There are no topographical maps of significance as yet issued.

Now, the Department of Agriculture, under its office of Artesian and Underflow Investigation, and of Irrigation Inquiry, received and expended between April 15, 1890, and May 1, 1892, just two years, the munificent sum of $70,000. During that time it made and has reported on two engineering, geological, and economic examinations of the Great Plains region, between 97° and 105° of longitude, and two reports besides on Irrigation proper. It prepared and issued six volumes in all, — a report on Artesian Wells, and the three parts you have noticed of the closing report on Artesian and Underflow Waters, also Progress Irrigation Report for 1891, and the volume referred to as "miscellaneous" by the review. As the work is in part only my own, though I edited all of it, I can justly challenge the value of it all in quality, as much as I may claim it exceeds the report in quantity, as compared with the Geological Survey. The three reports (six volumes or parts) embrace in all 1,694 pages, and some 58 valuable profiles, maps and geologic sections, besides more than 100 other special illustrations. The report (four parts) you reviewed has been printed to the number of but 1,733 copies for the use of Congress, and it has cost something less than $4,000. The other reports cost in all about $2,500 — a total estimate of $6,500. Since that publication, Congress has appropriated $6,000 more for Irrigation Inquiry. How much of this has been used I do not know; some of it I am aware has been wasted and I make the remark advisedly, as much as I regret to say anything except in approval of the Department of Agriculture.

The account stands then:—

A. Ten thousand copies (5,000 each volume under a general provision of law) of two reports, and some other reprinting by the U. S. Geological Survey, with a number of reservoir sites reserved on the public lands, most of which have been restored under later law by the Land Office to the Public Domain; the cost of all, at least, $465,000.

B. Eight reports in all by the Office of Irrigation Inquiry, Department of Agriculture, — three of the Engineers, three of the Geologists, and the same number of the Agent in charge (myself) — in all seven parts or volumes, containing the matter in brief, already stated, all this, too, in cost has been less than $80,000.

The Weather Service volume (chiefly Mr. Glassford's work) is above criticism and that of the U. S. Census Office in its "Irrigation Division" work is only an adjunct to the U. S. Geological Survey, unduly fostered by the Secretary of the Interior and the Superintendent of the Census to enable Director Powell to do that which the 51st Congress by withdrawal of a specific appropriation had forbidden him doing, viz., continue the work of irrigation survey and inquiry. The agent in charge was formerly an hydrographer in the Survey and was transferred to the Census. He has done better than it could have been anticipated he would from his first bulletins, but the work has cost far more than it is worth. That, too, from the value of the conditions and not the ability of the agent himself. Of course, it will be noticed most because it has the benefit of the expensive printing and publishing of the Census Office.

This whole irrigation inquiry has been characterized by a wasteful scramble to get in or on it. The State Department has published a volume thereon; the Treasury's Bureau of Statistics has dabbled therein in its volumes on "Internal Commerce"; the General Land Office has had its shy; the Weather Service is discussing "Earth Moisture," etc., and the Army Engineer Office got in a little one on Egypt. The Department of Agriculture only did what it was ordered and of late months not all of that.

RICHARD J. HINTON.
Member Am. So. of Irrigation Engrs.

Washington, Dec. 26.

Geographical Variation in Birds

In ornithology geography is the father of trinomial nomenclature. Climate is one great factor in variation, and topography has not a little to do with making the climate; but geography is unquestionably *the* cause of variable climate, else would the polar regions be tropical instead of frigid. Topography is at best local.

The variations of a species of birds, which make of it several sub-species, are due to its geographical distribution. These varying individuals do not take the name of "forms," as in entomology, but are set apart as true sub-species, each with a more or less well defined habitat of its own. But there is a serious difficulty in ascribing any sharp line of difference between the forms which intergrade on the outskirts of the geographical range, and a corresponding difficulty in ascribing any definite geographical limit. It is not seldom that individuals of one sub-species are found far within the range of another sub-species.

It is a little singular that certain species do not vary, species which are not only found from ocean to ocean in North America, but which are nearly or quite cosmopolitan. Why this should be true of some species and not of others is still an open question. If the scorching sun of the desert regions will bleach out one species why will it not do the same for another? The plea of adaptation of coloration for protection cannot be urged here.

Not only are colors affected, but size as well, by geographical position. This is probably more marked north and south than east and west. And yet the variation in size alone is not sufficient for a subspecific division. It is not at all strange that those individuals of a migratory species which push farthest north should possess stronger bones and muscles, and so be larger than those which were not able to fly so far. It would seem natural that the constant recurrence of such a difference would tend, in time, to form a race peculiar enough to be recognized as a sub-species. But it has not proven true thus far in the history of the world, and why should there be any change under the same conditions?

LYNDS JONES.

Oberlin, Ohio, Dec. 26.

On the Use of the Compound Eyes of Insects.

IN an interesting note on the above subject by Mr. E. T. Lewis in *Science* of Dec. 2, there is a reference to my note on Professor Exner's beautiful researches on the question of how the compound eyes of insects see, in my recent edition of "The Microscope and Its Revelations." Mr. Lewis says (p. 315), "but it may be as well to note that the figure on page 908 of 'The Microscope and Its Revelations' appears to have been laterally inverted by the engraver," his observations enabling him to say "that in the original photograph the letter R was not reversed as shown in the wood-cut, and the church faced the other way."

This is entirely fallacious; the wood-cut in the current edition of the "Revelations of the Microscope" is in every sense correct. It has been seen by Exner, and was copied from the original photograph, which now lies before me as sent me by Professor Exner himself; and a study of "Die Physiologie der Facettirten Augen von Krebsen und Insecten" will make this clear.

W. H. DOLLINGER.

Lee, London, S.E., England.

Discovery of Mexican Feather-Work in Madrid.

THERE are not many well-preserved specimens of native Mexicae feather-work in existence, and every addition to their number is of interest and importance. During a recent visit to the land which gave birth to the conquerors of Mexico, Mrs. Zelia Nuttall — whose researches on Mexican antiquities are well known — was so fortunate as to discover a fine example of Mexican feather-mosaic in the shape of a valuable shield, with an authentic history, preserved in the Royal Armory of Madrid. It is known as the shield of Philip the Second, for whom it was indubitably made in Spain of cane and leather in the oval shape of the Moorish *adarga*. It was then sent out to Mexico with four beautiful Spanish designs of historical scenes and a central device. These were executed in Mexico entirely of feather-mosaic, which covers the whole surface of the shield and makes it one of the most surprising and superb examples of this curious lost art of miniature painting with feathers. Mrs. Nuttall has paid considerable attention to the subject of ancient Mexican feather-work, and has already accumulated novel data which promise to throw light on the methods of its manufacture. We may look for an interesting paper on this subject from her pen before long.

Soon after the shield in question was identified by her as of Mexican workmanship — an unrecognized fact which was not recorded in the oldest Inventories — it was removed from the Royal Armory and placed on exhibition in the interesting Hispano-American Historical Exposition in Madrid. In the Spanish section of the same building may now be found also the elaborate tables, fourteen metres long, originally dasigned to illustrate Mrs. Nuttall's "Preliminary Note on the Ancient Calendar of the Axtecs," which formed the most original and valuable communication presented to the recent Americanist Congress at Huelva. It was then generally admitted that Mrs. Nuttall had fairly solved the great problem which has long puzzled Mexicanist students in general. Guided by a luminous passage occurring in an unpublished Hispano-Mexican MS. which she had previously discovered in a Florentine library and intends to reproduce in *fac-simile*, Mrs Nuttall may be said to have furnished the key to the hitherto unknown calendar system of the ancient Aztecs. It now seems to be of a very simple and harmonious character and to have been employed by them, judging from astronomical calculations, for a period of at least 4,000 years.

The Mexican cycle, it appears from these researches, was one of 13,515 days. It comprised 52 *ritual* years, less five days at the end of the cycle, each year of 260 days, or 51 *lunar* years of 265 days, based on nine moons in each year, or 37 *solar* years of 365 days in each year. At the end of the fifty-first *lunar* year ten intercalated days made the *lunar* year equal to the *solar* year, in such a manner that the new cycle began in the same lunar and solar positions as the preceding cycle of 13,515 days. Each period began with a day bearing one of four names, *acatl*, *tecpatl*, *calle'*, or *tochtle'*.

This is the most important discovery hitherto made known by the indefatigable Nahuatl scholar. Full details will eventually be published in one of the Peabody Museum papers of the American Museum of Archæology, on which Mrs. Zelia Nuttall, special assistant in Mexican archæology, and director of the same department in the Columbian Exhibition, has already reflected much honor.

AGNES CRANE.

Brighton, England, Dec. 20, 1892.

Is it Instinct or Intelligence?

I HAVE a nearly pure-blooded water spaniel. Though a great pet and most valuable watch-dog, in my busy life I have devoted little time to training him, — rather have watched carefully the development and application of his own powers, under a uniformly kind treatment. When only five weeks old, he made his first debut into the open world, — following mother and myself to church. Crossing the street, we heard the patter of little feet, and, looking around, I saw his nose close to the ground as the little ball trudged along. I took him home and started again, only to have the performance repeated, but this time I shut him in the house. Just as church service opened, mother thought she felt something strangely warm at her feet. And lo! there was Master Carlo. He had escaped, perseveringly followed our track around two blocks, and discovered mother in the congregation. From that time a remarkably keen scent has been a prominent quality. Early he manifested a love for watching and chasing chickens, — a pastime not to be neglected with the small opportunities of the city. We soon, by kindness and firmness and much talking, broke him of disturbing our own chickens. We often took a little chick in our hands, and said to him "pretty chickey, Carlo's chickey!" and allowed him to lick it gently. Soon it was not only safe, but safer to have him in the pen with the chicks than otherwise, as then no rat or mouse dared venture there. From the first, Carlo has deemed these marauders worthy of death whenever and wherever seen, and acts out his convictions. As the chickens grew, and Thanksgiving approached, their number was reduced to twelve, and these were transferred to the barn. Every night for two years Carlo made a detour of the perches, giving each fowl a good lick, — they were so acquainted it did not alarm them at all, — and if one or more of the number was absent, he would immediately scour the premises till it was found, then gave a peculiar bark indicating the discovery; nor would he give it up till the number was complete. Could he count? How did he know there should be just twelve — no more, no less? Occasionally a stray fowl would come to our yard. This he tormented by keeping it constantly "on the move," not by making it run, but simply kept it walking about, persistently, unless it flew to the street, when he considered it game, and pursued it thoroughly. The following spring and summer, as the chicks began to lay, he took it upon himself, without any teaching by us, to find and bring in the eggs, never sucking any, and rarely breaking them; if broken, it was because he laid them down carelessly upon the veranda floor. When a

hen stole her nest, he was sure to miss her and search her out, then get her eggs, if he could reach them; if unable to do so, he would stand and whine till aid came. In our daily drives, Carlo was accustomed to go with mother and me, so when left at home he was very sad. To deceive him as to our going, we came to spell the words *go*, *barn* and *ride*. For a few days the plan succeeded well, but, regardless of special tone or other (to us) apparent association, he soon pricked up his ears at the sound "g-o," and that mystery was solved, then followed "r-i-d-e" and "b a-r-n," till those combinations were nearly as significant of a pleasure-hour to him as to us.

During mother's long and severe illness, he took great interest in all that pertained to her, watching the doctor very closely, and sitting, by the half-hour, with his chin on the bed by her side. We bought our bread, and, knowing Carlo's fondness for warm biscuit, the baker often gave him one which he quickly despatched. Once, during a very severe attack of mother's, when we were doing our utmost to tempt her appetite, Carlo came in early one morning, bringing his warm biscuit untouched, and laid it on the floor by mother's side. Too sick to notice this act of his, but not to be disappointed in his own plan, he came forward and lifted the biscuit to her pillow, and retired again to his corner to wait some look of thanks from her. It came, and such a happy dog! He had brought his choicest offering — a warm biscuit — and it had been recognized. Was there a loving plan and careful observation in this act?

One day while busy writing, I heard him in the dining-room asking to go out. The outside doors were open, and I said "Yes, Carlo may go!" and returned to my desk. Soon he repeated his request, and I rose saying "Now you must go, and not bother me so!" but he lay quietly, though anxiously, in the middle of the floor. Going to him, I found he had my canary between his front feet, not a feather injured, but waiting for me to release it in safety. The cage had accidently been left open, and finding the bird free, with these outside doors of the room open, he had gently caught and held my pet. Why should he catch it when the doors were open, when if closed he made no such effort? Who will say this was mere instinct? MARY E. HOLMES.

Rockford, Ill.

BOOK-REVIEWS.

Deep-Sea Sounding. By CAPT. A. S. BARKER, U.S.N. New York, J. Wiley & Sons, 1892. 133 p. Maps. 8°.

CAPTAIN BARKER, in this very interesting work, gives an account of the results of the explorations of deep-sea bottoms by the officers of the U.S.S. "Enterprise" in the years 1883–1886. The casts of the lead were made by Messrs. Norris and Marix, lieutenants attached to the "Enterprise," the one on the outward, the other on the homeward voyage. The ship sailed and steamed across the Atlantic and the Indian Oceans, and returned by way of the Pacific, sounding out different routes. Soundings were made daily, often for many days together; steam being raised for the purpose each time, and the fires allowed to go out again immediately after the cast. With characteristic naval spirit, the author assumes all responsibility for even the minutest detail, as where he says "*my* usual custom, during the cruise, was to use only two boilers when steaming," and where similar assumptions of credit in regard to details for which other officers were responsible, and which a commanding officer in the merchant service would have given credit for, and left absolutely, to the person best prepared by experience and judgment to perform. The two lieutenants who did the work, and the chief engineer, are, however, complimented as officers "whose intelligence, zeal, and devotion to duty could not be surpassed." This innocent and unconscious self-assertion runs through the book.

The volume is very interesting, however, and contains much new and valuable information and data. New submarine mountain ranges were discovered, and previously unknown obstructions to navigation. The voyage terminated at the further side of the Indian Ocean, immediately after the great eruption of Krakatoa;

CALENDAR OF SOCIETIES.

Society of Natural History, Boston.

Jan. 4.—W. G. Farlow, Account of Some of the Botanical Establishments of Europe; J. Eliot Wolff, Application of the Microscope to the Study of Rocks.

Entomological Society, Washington.

Dec. 31.—The eighth annual and eighty-fifth regular meeting of the society was held at the residence of the president, Dr. C. V. Riley. The following officers were elected: President, C. V. Riley; vice-presidents, W. H. Ashmead and C. W. Stiles; recording secretary, C. L. Marlatt; corresponding secretary, L. O. Howard; treasurer, E. A. Schwarz; executive committee, the officers and Dr. W. H. Fox, Dr. Geo. Marx, and Mr. B. E. Fernow. Mr. Frank Benton was elected an active member. The retiring president, Dr. C. V. Riley, then delivered his annual address on the subject of "Parasitism in Insects." The address began with a definition of the term and a classification of the subject, and then treated in detail the following subdivisions: (1) The parasites among insects proper, by orders; (2) origin of insect parasitism; (3) effects of the parasitic life; (4) economic bearings of the subject. At the conclusion of the address, on motion of Dr. Gill, the thanks of the society were voted to the president.

Kindly mention "Science" in writing to Advertisers.

TWO UNUSUALLY GOOD OFFERS.

REAL CHRISTMAS GIFTS.

FIRST.—The great Holiday Number (enlarged to 256 pages) of that brightest of quarterly publications.

"TALES FROM TOWN TOPICS,"

Out December 1st, all news and book stands and railway trains, price, 50 cts., will be sent

FREE

To all who send $1.00 for 3 months' trial subscription to

TOWN TOPICS.

The largest, raciest, strongest, most varied and entertaining weekly journal in the world.

SECOND.—To all who will send $5.00, will be sent TOWN TOPICS and "TALES FROM TOWN TOPICS," from date until January 1, 1894, covering 5 numbers of the inimitable quarterly (regular price $2.50) and 14 months of the greatest of family weeklies (regular price $4.00 per year).

☞Take one or the other offer AT ONCE and remit in postal notes, orders, or New York Exchange to

TOWN TOPICS, 21 West 23d St., N Y.

Fact and Theory Papers

I. THE SUPPRESSION OF CONSUMPTION. By GODFREY W. HAMBLETON, M.D. 12°. 40c.
II. THE SOCIETY AND THE "FAD." By APPLETON MORGAN, Esq. 12°. 20 cents.
III. PROTOPLASM AND LIFE. By C. F. COX. 12°. 75 cents.
IV. THE CHEROKEES IN PRE-COLUMBIAN TIMES. By CYRUS THOMAS. 12°. $1.
V. THE TORNADO. By H. A. HAZEN. 12°. $1.
VI. TIME-RELATIONS OF MENTAL PHENOMENA. By JOSEPH JASTROW. 12°. 50c.
VII. HOUSEHOLD HYGIENE. By MARY TAYLOR BISSELL. 12°. 75 cents.

N. D. C. HODGES, Publisher,
874 Broadway, New York.

Reading Matter Notices.

Ripans Tabules: best liver tonic.

Ripans Tabules cure jaundice.

MINERALS. Cabinet Specimens, Collections, and material by the pound, for mineralogists, collectors, colleges, schools, and chemists. Send for 100-page catalogue, paper bound, 15 cents; cloth bound, 25 cents; supplement 2 cents. GEO. L. ENGLISH & Co., Mineralogists, 723 & 735 B'way, N. Y.

BACK NUMBERS and complete sets of leading Magazines. *Rates low.* AM. MAG. EXCHANGE, Schoharie N Y

RESTORE YOUR EYESIGHT

Cataracts, scars or films can be absorbed and paralyzed nerves restored, **without the knife or risk.** Diseased eyes or lids can be cured by our **home treatment.** "We prove it." **Hundreds convinced.** Our illustrated pamphlet, 'Home Treatment for Eyes," free. Don't miss it. Everybody wants it. "THE EYE," Glens Falls, N.Y.

FOR SALE.

Audubon's "Birds of America," 7 vols.; Audubon's "Quadrupeds of America," 3 vols.; McKenney's "Indian Tribes of America," 3 vols. Price, $200. Address

C. A. MOUTON, Lafayette, La.

and the exploration of the desolated islands of that neighborhood formed one of the most interesting parts of the work. Depths were reached in the Atlantic exceeding 4,500 fathoms, and a line across the South Pacific was the first ever made in deep-sea sounding. The visit to Australia was especially interesting. The opinion of the author is highly favorable to that growing empire of the distant seas. He thinks the "working people" of Australia have more influence than elsewhere, and that their average intelligence exceeds that of our own people even. The four millions are "a whole-souled and gallant race," and the visitors "left their country with a genuine love for the people and a firm belief in their future greatness." The "Enterprise" sailed on Jan. 3, 1883, and went out of commission, after having thus in three years circumnavigated the globe, March 31, 1886. The log of the soundings, and the roll of the officers and men, are appended to the book, which is continuously of interest from its first page to the last.

Elements of Graphical Statics. By L. M. HOSKINS. New York and London, Macmillan & Co., 1892. 8vo. pp. viii., 191. Pl. v. $2.25.

THIS work is an elementary text-book for use of students in engineering. Fundamental principles and simple methods of treatment are illustrated, and illustrated well. The funicular and other polygons, and figures related to them, are deduced from statical principles. The theory of elasticity is omitted. Bow's notation has been adopted and extended, and the lettering of both the force and the space diagrams is thus made at once convenient and intelligible. The whole constitutes an excellent graphical discussion of the general and fundamental principles of mechanics, and in such form as to be especially useful in applications by the engineer in design and construction. The tracing of the forces involved in the framing of structures and the relations of efforts and resistances in such constructions is, by these methods — now becoming well known and extensively applied — made both easy and simple. The work is likely to prove valuable both in instruction and in office work.

AMONG THE PUBLISHERS.

THE ninth volume in the series of technological handbooks issued by George Bell & Sons, London (Macmillan, New York), is devoted to "Silk Dyeing, Printing, and Finishing," by George H. Hurst, F.C.S. The substance of the book consists of a series of articles contributed to a technical journal, though they have been revised and to some extent rewritten. In addition to these there are added chapters on silk printing and finishing, and on the testing of dyed silks. The methods of using all the new coal-tar colors, which have of late years led to new developments in silk dyeing, have been included. The book is a thoroughly practical one, not a mere collection of recipes — though recipes are not lacking. The appendix contains a series of patterns illustrative of the tints and shades produced in the dyeing of silks. (237 pages. 12°. $2.)

— Macmillan & Co. have just issued a revised and enlarged second edition of "Blowpipe Analysis," by J. Landauer, member of the Imperial German Academy of Naturalists (authorized English edition by James Taylor, B.Sc., Wh. Sc., A.R.S.M. The soundness of the principles on which the work is based is attested by the favorable reception accorded to it in the various languages into which it has been translated, as well as by the fact that new editions have been found necessary. In the present edition not only has the text been completely revised, but new methods of approved value have been incorporated, so as to bring the work up to the present time. Some additional details of manipulation will be found of value by readers who are working up the subject without a teacher. A handsome plate of the spectra of the metals of the alkalies and alkali groups, from the drawings of Bunsen and Kirchhoff forms the frontispiece. (173 pages. 12°. $1.10.)

Dyspepsia

Dr. T. H. Andrews, Jefferson Medical College, Philadelphia, says of

Horsford's Acid Phosphate.

"A wonderful remedy which gave me most gratifying results in the worst forms of dyspepsia."

It reaches various forms of Dyspepsia that no other medicine seems to touch, assisting the weakened stomach, and making the process of digestion natural and easy.

Descriptive pamphlet free on application to

Rumford Chemical Works, Providence, R. I.

Beware of Substitutes and Imitations.

For sale by all Druggists.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For sale or exchange.—A private cabinet of about 200 species of fossils, well distributed geologically and geographically. Silurian, about 40; Devonian, about 50; Carboniferous, about 80; others, about 30. Frank S. Aby, State University, Iowa City, Ia.

For exchange.—Minerals, fossils, F. W. shells, land shells, native woods, Indian relics, two vols. of Smithsonian reports, odd numbers of scientific magazines, copper cents, etc., for good minerals not in my collection, good arrow- and spear-heads and natural history specimens of all kinds. Correspondence solicited with list of duplicates. G. E. Wells, Manhattan, Kan.

For sale or suitable exchange.—A spectrometer made by Fauth & Co., Washington, D. C., according to the plan of Prof. C. A. Young. This instrument is suitable for the most advanced investigations and determinations. Cost originally $700 and has been used but little. Will be disposed of at a considerable reduction. Address Department of Physics, Ohio University, Athens, O.

I will send British land and fresh-water shells in return for those of America, any part, sent to me. I have at present about fifty or sixty species, with many varieties. W. A. Gain, Tuxford, Newark, England.

The Biological Department of Hamline University desires to offer microscopic slides of animal tissues, or whole animals, in exchange for first-class fossils. Address correspondence to Henry L. Osborne, Hamline University, Hamline, Minn.

For sale.—A set of the Berichte der Deutschen Chemischen Gesellscaft, from Jan. 1, 1877, to Jan. 1 1892, bound in twenty-six volumes to Jan. 1, 1888 and remaining four years unbound. Also the Bulletin de la Société Chemique de Paris, from Jan. 1 1879, to Jan. 1, 1892, bound in eighteen volumes to Jan. 1, 1888, and remaining four years unbound. Dr. Marcus Benjamin, care of D. Appleton & Co., 1 Bond St., New York City.

Wants

WANTED.—American Journal of Conchology, seven volumes. Parties having these for sale will please address the undersigned, stating condition and price. R. Ellsworth Call, Louisville, Ky.

A GRADUATE ENGINEER will give instruction evenings in geometry, trigonometry and surveying, mechanics, physics, mechanical drawing and general engineering construction. Five years' experience in field and editorial work on engineering journal. References furnished. C. S. H., 102 Tribune Building, New York.

A POSITION is desired in the South, preferably the Gulf States, where I can teach the sciences Can also instruct in other branches. Salary only nominal, as I am simply desirous of employment while spending the winter in the South. A private family preferred, but will accept regular school work if not too confining. MORRIS GIBBS, M.D, Kalamazoo, Mich.

WANTED.—By well-qualified and experienced science master and associate of the Royal School of Mines, London, aged 26 (at present in England), a mastership in technical college or university for any of the following subjects: Engineering sciences. geology and mineralogy, physics, chemistry and metallurgy, etc., etc. Can provide excellent references and credentials. Apply, J. G., 17 Sussex St., Rochdale, England.

A GRADUATE of the University of Pennsylvania and a practical mineralogist of twenty years' experience desires to give his services and a cabinet of 25,000 specimens, all named, with about the same number of duplicates, in minerals, crystals, rocks, gems, fossils, shells, archæological and ethnological specimens and woods to any institution desiring a fine outfit for study. The owner will increase the cabinet to 50,000 specimens in two years and will act as curator. Correspondence solicited from any scientific institution. J. W. Hortter, M.D., Ph.D., San Francisco, Cal., General P. O. Delivery.

The American Geologist for 1893.

Edited by PROF. S. CALVIN, University of Iowa; DR. E. W. CLAYPOLE, Buchtel College; JOHN EYERMAN, Lafayette College; DR. PERSIFOR FRAZER, Penn. Hort. Soc.; PROF. F. W. CRAGIN, Colorado College; PROF. ROB'T T. HILL, U. S. Irrigation Survey; DR. ANDREW C. LAWSON, University of California; Frank D. KNOWLTON, U. S. National Museum; JOSEPH B. TYRRELL, Geol. Sur. of Canada; E. O. ULRICH, Minnesota Geological Survey; PROF. I. C. WHITE, University of West Virginia; PROF. N. H. WINCHELL, University of Minnesota. Now in its Xth volume. $3 50 per year. Sample copies, 20 cents. Address

THE GEOLOGICAL PUBLISHING CO., Minneapolis, Minn.

"For enlightened owners of gardens and woodlands this journal is invaluable."—*N. Y. Tribune.*

Filled every week with original, entertaining and exact information from the best American and European authorities about trees, shrubs, flowers and fruits; the beautifying of home-grounds, roadsides and parks; the preservation of forests and of natural scenery, together with vigorous editorial treatment of topics within its field and illustrations of the highest artistic finish.

"The foremost journal of its class."—*Boston Herald.* "A capital specimen of pure literature."—*N. Y. Journal of Commerce.* "The arbiter in matters of rural taste."—*Boston Transcript.* "Crisp and fresh text."—*N. Y. Tribune.* "Illustrations of rare excellence."—*Buffalo Courier.* "Edited with signal ability."—*Cin. Times-Star.*

Published Weekly. $4.00 a year.

☞*Send for Specimen Copy of Garden and Forest and special net clubbing rates with other periodicals.*

GARDEN AND FOREST PUBLISHING CO.,
TRIBUNE BUILDING, NEW YORK.

THE American Bell Telephone COMPANY.

95 MILK ST., BOSTON, MASS.

This Company owns the Letters Patent granted to Alexander Graham Bell, March 7th, 1876, No. 174,465, and January 30, 1877, No. 186,787.

The Transmission of Speech by all known forms of ELECTRIC SPEAKING TELEPHONES infringes the right secured to this Company by the above patents, and renders each individual user of telephones, not furnished by it or its licensees, responsible for such unlawful use, and all the consequences thereof and liable to suit therefor.

A perfect and practical Type Writing machine for only ONE DOLLAR. Exactly like cut; regular Remington type; does the same quality of work; takes a fools cap sheet. Complete with paper holder, automatic feed, perfect type wheel & inking roll; uses copying ink. Size 3x4x9 inches; weight, 12 oz; Satisfaction guaranteed; Circulars free; AGENTS WANTED. Sent by express for $1.00; by mail, 15c. extra for postage.
R. H. INGERSOLL & Bro. 65 Cortlandt St. N. Y. City.

TO THOSE INTERESTED IN SCIENCE.

[Science (weekly) established in 1883, N. D. C. HODGES, 874 Broadway, New York City.]

Titles of Some Articles Published in *Science* since Jan. 1, 1892.

Aboriginal North American Tea.
Actinism.
Agriculture, Experimental, Status of.
Amenhotep, King, the tomb of.
Anatomy, The Teaching of, to Advanced Medical Students.
Anthropology, Current Notes on.
Architectural Exhibition in Brooklyn.
Arsenical Poisoning from Domestic Fabrics.
Artesian Wells in Iowa.
Astronomical Notes.
Bacteria, Some Uses of.
Bird on Its Nest, The.
Birds Breeding at Hanover, N. H.
Botanical Laboratory, A.
Botanists, American and Nomenclature.
Brain, A Few Characteristics of the Avian.
Bythoscopidæ and Cereopidæ.
Canada, Royal Society of.
Celts, The Question of the.
Chalicotherium, The Ancestry of.
Chemical Laboratory of the Case School.
Children, Growth of.
Collection of Objects Used in Worship.
Cornell, The Change at.
Deaf, Higher Education of the.
Diamonds in Meteorites.
Diphtheria, Tox-Albumin.
Dynamics, Fundamental Hypotheses of.
Electrical Engineer, The Technical Education of.
Eskimo Throwing Sticks.
Etymology of two Iroquoian Compound Stems.
Eye-Habits.
Eyes, Relations of the Motor Muscles of, to Certain Facial Expressions.
Family Traits, Persistency of.
Fishes, The Distribution of.
Fossils, Notice of New Gigantic.
Four-fold Space, Possibility of a Realization of.
Gems, Artificial, Detection of.
Glacial Phenomena in Northeastern New York.
Grasses, Homoptera Injurious to.
Great Lakes, Origin of the Basins of.
"Healing, Divine."
Hemipterous Mouth, Structure of the.
Hofmann, August Wilhelm von.
Hypnotism among the Lower Animals.
Hypnotism, Traumatic.
Indian occupation of New York.
Infant's Movements.
Influenza, Latest Details Concerning the Germs of.
Insects in Popular Dread in New Mexico.
Inventions in Foreign Countries, How to Protect.
Inventors and Manufacturers Association.
Iowa Academy of Sciences.
Jargon, The Chinook.
Jassidæ; Notes on Local.
Keller, Helen.
Klamath Nation, Linguistics.
Laboratory Training, Aims of.
Lewis H. Carvill, Work on the Glacial Phenomena.
Lightning, New Method of Protecting Buildings from.
Lion Breeding.
Lissajou's Curves, Apparatus for the Production of.
Maize Plant, Growth and Chemical Composition of.
Maya Codices, a Key to the Mystery of.
Medicine, Preparation for the Study of.
Mineral Discoveries, Washington.
Museums, The Support of.
Palenque Tablet, a Brief Study of.
Patent Office Building, The.
Physa Heterostropha Say, Notes on the Fertility of.
Pict's House, A.
Pocket Gopher, Attempted Extermination of.
Polariscopes, Direct Reflecting.
Psychological Laboratory at Toronto.
Psychological Training, The Need of.
Psylla, the Pear-Tree.
Rain-Making.
Rice-Culture in Japan, Mexico and the United States.
Rivers, Evolution of the Loup, in Nebraska.
Scientific Alliance, The.
Sistrurus and Crotalophorus.
Star Photography, Notes on.
Star, The New, in Auriga.
Storage of Storm-Waters on the Great Plains.
Teaching of Science.
Tiger, A New Sabre-Toothed, from Kansas.
Timber Trees of West Virginia.
Tracheæ of Insects, Structure of.
Vein-Formation, Valuable Experiments in.
Weeds as Fertilizing Material.
Weeds, American.
Will, a Recent Analysis of.
Wind-Storms and Trees.
Wines, The Sophisticated French.
Zoology in the Public Schools of Washington, D. C.

Some of the Contributors to *Science* Since Jan. 1, 1892.

Aaron, Eugene M., Philadelphia, Pa.
Allen, Harrison, Philadelphia, Pa.
Ashmead, Albert S., New York City.
Bailey, L. H., Cornell University, Ithaca, N. Y.
Baldwin, J. Mark, University of Toronto, Canada.
Ball, V., C. B., LL.D., F.R.S., Dublin, Ireland.
Barnes, Charles Reid, Madison, Wis.
Baur, G., Clark University, Worcester, Mass.
Beal, W. J., Agricultural College, Mich.
Beals, A. H., Milledgeville, Ga.
Beauchamp, W. M., Baldwinsville, N.Y.
Bell, Alexander Graham, Washington, D. C.
Boas, Franz, Clark University, Worcester, Mass.
Bolley, H. L., Fargo, No. Dak.
Bolles, Frank, Cambridge, Mass.
Bostwich, Arthur E., Montclair, N J.
Bradley, Milton, Springfield, Mass.
Brinton, D. G., Philadelphia, Pa.
Call, E. Ellsworth, Des Moines, Ia.
Chandler, H., Buffalo, N.Y.
Comstock, Theo. B., Tucson, Arizona.
Conn, H. W., Middletown, Conn.
Coulter, John M., Indiana University.
Cragin, F. W., Colorado Springs, Col.
Cresson, Hilborne T., Philadelphia, Pa.
Davis, W. M., Harvard College, Cambridge, Mass.
Dimmock, George, Canobie Lake, N.H.
Dixon, Edward T., Cambridge, England.
Farrington, E. H., Agric. Station, Champaign, Ill.
Ferree, Barr, New York City.
Fessenden, Reginald A., Lafayette, Ind.
Flexner, Simon, Johns Hopkins, Baltimore, Md.
Foshay, P. Max, Rochester, N.Y.
Gallaudet, E. M., Kendall Green, Washington, D.C.
Garman, S., Mus. Comp. Zool., Cambridge, Mass.
Gibbs, Morris, Kalamazoo, Mich.
Golden, Katherine E., Agric. College, Lafayette, Ind.
Grinnell, George B., New York City.
Hale, Edwin M., Chicago, Ill.
Hale, George S., Boston, Mass.
Hale, Horatio, Clinton, Ontario, Canada.
Hall, T. Proctor, Clark University, Worcester, Mass.
Halsted, Byron D., Rutg. Coll., New Brunswick, N.J.
Haworth, Erasmus, Oskaloosa, Iowa.
Hay, O. P., Irvington, Ind.
Haynes, Henry W., Boston Mass.
Hazen, H. A., Weather Bureau, Washington, D.C.
Hewitt, J. N. B., Bureau of Ethnol., Washington, D. C.
Hicks, L. E., Lincoln, Neb.
Hill, E. J., Chicago, Ill.
Hill, Geo. A., Naval Observatory, Washington, D.C.
Hitchcock, Romyn, Washington, D.C.
Holmes, E. L. Chicago, Ill.
Hoskins, L. M., Madison, Wis.
Hotchkiss, Jed., Staunton, Va.
Houston, Edwin J., Philadelphia, Pa.
Howe, Jas. Lewis, Louisville, Ky.
Hubbard, Gardiner G., Washington, D.C.
Jackson, Dugald C., Madison, Wisconsin.
James, Joseph F., Agric. Dept., Washington, D.C.
Johnson, Roger B., Miami University, Oxford, O.
Keane, A. H., London, England.
Kellerman, Mrs. W. A., Columbus, O.
Kellicott, D. S., State University, Columbus, O.
Kellogg, D. S., Plattsburgh, N. Y.
Lintner, J. A., Albany, N. Y.
Loeb, Morris, New York City.
Mabery, Charles F., Cleveland, Ohio.
Macloskie, G., Princeton, N.J.
McCarthy, Gerald, Agric. Station, Raleigh, N. C.
MacDonald, Arthur, Washington, D.C.
MacGregor, J. C., Halifax, Nova Scotia.
MacRitchie, David, Easter Logie, Perthshire, Scotland.
Marshall, D. T., Metuchen, N.J.
Mason, O. T., Smithsonian Inst., Washington, D. C.
Millspaugh, Charles F., Morgantown, W. Va.
Morse, Edward S., Salem, Mass.
Nichols, C. F., Boston, Mass.
Nuttall, George H. F., Johns Hopkins, Baltimore Md.
Oliver, J. E., Cornell University, Ithaca, N.Y.
Osborn, Henry F., Columbia College, New York City.
Osborn, Herbert, Agricultural College, Ames, Iowa.
Pammel, L. H., Agricultural Station, Ames, Iowa.
Pillsbury, J. H., Smith College, Northampton, Mass.
Poteat, W. L., Wake Forest, N. C.
Preble, Jr., W. P., New York City.
Prescott, Albert B., Ann Arbor, Mich.
Riley, C. V., Washington, D. C.
Ruffner, W. H., Lexington, Va.
Sanford, Edmund C., Clark Univ., Worcester, Mass.
Scripture, E. W., Clark University, Worcester, Mass.
Seler, Dr. Ed., Berlin, Germany.
Shufeldt, R. W., Washington, D.C.
Slade, D. D., Museum Comp. Zool., Cambridge, Mass.
Smith, John B., Rutgers Coll., New Brunswick, N. J.
Southwick, Edmund B., New York City.
Stevens, George T., New York City.
Stevenson, S. Y., Philadelphia, Pa.
Stone, G. H., Colorado Springs, Col.
Taylor Isaac, Settrington, England.
Thomas, Cyrus, Washington, D. C.
Thurston, R. H., Cornell University, Ithaca, N.Y.
Todd, J. E., Tabor, Iowa.
True, Frederick W., Nat. Mus., Washington, D.C.
Turner, C. H., Univ. of Cincinnati, Cincinnati, O.
Wake, C., Staniland, Chicago, Ill.
Ward, R. DeC., Harvard Univ., Cambridge, Mass.
Ward, Stanley M., Scranton, Pa.
Warder, Robert B., Howard Univ., Washington, D.C.
Welch, Wm. H., Johns Hopkins, Baltimore, Md.
West, Gerald M., Clark University, Worcester, Mass.
Whitman, C. O., Clark University, Worcester, Mass.
Williams, Edward H., Lehigh Univ., Bethlehem, Pa.